

PATENT

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12-22-89

IN THE UNITED STATES PATENT & TRADEMARK OFFICE



Art Unit: 126

Examiner: J. Reamer

P.D. File No.: 30-20004 (4690)

Applicants: Richard R. Hertzog et al.

Serial No.: 297,333

Filed: January 17, 1989

For: DECOMPOSITION OF CUMENE OXIDATION PRODUCT

Petersburg, Virginia 23804  
November 30, 1989

REQUEST FOR RECONSIDERATION

Commissioner of Patents  
Washington, DC 20231

Sir:

This is responsive to the office action of May 30, 1989. A shortened statutory period for response was set to expire 3 months from the date of the office action. A request for a three month extension of the period for response to November 30, 1989, together with the requisite fee, accompany this response.

Reconsideration of the examiner's action is respectfully requested.

Applicants have disclosed that to obtain high alpha-methyl styrene (AMS) yields under stable operating conditions with enhanced safety of operation and reduced by-product formation a two stage operation is used. In the first stage, CHP is decomposed in a back-mixed reactor in the presence of acetone so that residual CHP concentration is between about 0.2 and about 3.0 weight percent. In the second stage, the reaction is completed in a plug-flow reactor at 120° to 150°C. An optional plug-flow third stage, claimed in claim 2, may be used to reduce CHP concentration between these two stages.

Claims 1 to 8 stand rejected under 35 U.S.C. 103 as unpatentable over Sifniades et al. in combination with

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Barilli et al., Langley, or Anderson. U.K. patent 1,202,687 is thought to be an English language equivalent to the German 1,915,480 cited by the examiner, and is referred to hereafter as Barilli et al.

Sifniades et al. teaches the use of a three stage operation but without acetone recycle. Barilli et al., Langley, and Anderson all teach the use of acetone, but in a single stage reaction.

The examiner states "The second step in the process of Sifniades et al. is not necessary when acetone is used in the first step since the secondary references show that the cumene hydroperoxide concentration is reduced sufficiently using the acetone solvent that the plug-flow reaction is not necessary." However, applicants show that surprisingly this is not the case. With reference to the examples of Table I and to Figure 2, examples 1 through 6 and 12, with acetone recycle of 40 and 60%, when plotted in Figure 2 clearly show a steep increase in AMS yield as residual CHP in the back-mixed reactor is allowed to increase from zero up to about 0.2 weight percent, and there is further a more gradual yield improvement as residual CHP increases up to 3 weight percent.

AMS is formed essentially by dehydration of DMPC which is formed along with CHP during oxidation of cumene. The yield of AMS, besides representing the yield of a valuable by-product, is also a measure of the suppression of high-boiling tars. These are chiefly AMS dimers and cumyl phenol. If allowed to persist to the distillation train, DCP is also a source of tars. Cumyl phenol and DCP engender loss of phenol as well as AMS. Therefore, AMS yield, as defined on page 11, lines 10 to 15 of the application, generally correlates with phenol yield.

The AMS yield in example 12 was 62.6% after a single stage reaction in a stirred reactor (p. 11, line 26). No residual CHP was present in the product, therefore this example represents the outcome of a process with acetone

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solvent as referred to by the examiner and corresponds to the one stage process with acetone shown in the secondary references. The AMS yield increased to 68.1% upon further reaction at 125°C in a tube reactor. This effect is thought to be due to a small amount of DCP (0.55 wt. percent) that was formed in the stirred reactor and decomposed to produce AMS, phenol and acetone in the tube reactor. This result shows that even when operating with acetone solvent with zero residual CHP, a two stage process is beneficial. Nevertheless, we limit our claims to a two stage process in which the residual CHP after the first stage is at least 0.2 wt. percent because the AMS yield is significantly higher in such a process. This result is respectfully submitted to provide a showing of unexpected results over the teachings of the cited prior art.

A different perspective of applicants' invention is as follows. The prior art teaches that when acetone is used as solvent in CHP decomposition, higher yields of phenol are obtained. However, the mere presence of acetone does not guarantee high yields; other reaction conditions, such as temperature, level of catalyst and residence time must be fine tuned. This is due to the fact that the synthesis of phenol, acetone and AMS from technical CHP stock is a complex process that encompasses several simultaneous and consecutive reactions. Product yields peak out in a rather narrow range of conditions. If reaction in a back-mixed reactor is allowed to proceed beyond optimal CHP conversion, yields decline. Thus the AMS yield (which we have shown to correlate with phenol yield) in example 12 of our disclosure could be made much smaller (e.g. 30%) by using more sulfuric acid and/or increasing the residence time. The resulting residual CHP would still be zero. In other words, if the reaction is carried out to complete CHP decomposition, there is no convenient measure of the severity of reaction. Our invention, by specifying that the effluent from the

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back-mixed reactor contains at least 0.2 wt. percent CHP, ensures that the yield has not peaked out. The reaction is then completed in a second stage in a plug-flow reactor in which residual DCP provides the criterion of the optimal extent of reaction.

In view of the discussion above, it is respectfully submitted that the claimed process is not taught or suggested by the cited references, or alternatively that the increase in AMS yield provided by utilization of the second stage provides a showing of unexpected results. Accordingly, it is requested that the rejection be withdrawn, and the claims passed to issue.

Respectfully submitted,

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WHT/rbk

I HEREBY CERTIFY THAT THIS CORRESPONDENCE IS BEING DEPOSITED WITH THE UNITED STATES POSTAL SERVICE AS FIRST CLASS MAIL IN AN ENVELOPE ADDRESSED TO: COMMISSIONER OF PATENTS & TRADEMARKS, WASHINGTON, D.C. 20231  
November 30, 1989

ON \_\_\_\_\_ DATE \_\_\_\_\_

William H. Thrower

NAME OF APPLICANT, ASSIGNEE, OR APPLICANT'S ATTORNEY

William H. Thrower

SIGNATURE

November 30, 1989

DATE